

aim; no biological conclusions are attempted nor structural details given, save such as appertain to generic or specific diagnosis. Its value therefore is to the student of the local fauna and the generaliser in the study of geographical distribution.

The work of course must be considered to a certain extent as introductory only; many species will necessarily be discovered and added to the fauna, whilst of those described it is equally probable that some will prove of synonymic value only. The last conjecture becomes almost a certainty when an estimate is made of the difficulties under which Prof. Berg must have worked, so far removed from all the large collections, identifying or separating frequently by the help of poor descriptions, with the impossibility of examining the original types. His descriptions however are very clear, and have as a rule appended the *differentia specifica* from a nearly allied form. It is much to be regretted that this course is not more usually followed by some other entomologists, and it would almost appear in many cases that from being so frequently told by the biological philosopher that descriptive is the lowest form of scientific work, that the describers themselves in despair had done the work in the very lowest manner. It was well said that "some see differences and no resemblance, others resemblance and no difference, whilst some again can see neither the one nor the other," and thus the help acquired from comparative diagnosis appended to an exhaustive description becomes the more necessary when it is not possible to give a figure of the species. Whatever conception may apply in the mind of the individual worker as to the much vexed term "species," it is at least to be expected that the limits of variation can only be estimated by one who has thoroughly studied a group and knows some little of their life histories. It is in this field that the specialist should really be considered a prophet, and in entomology there are not only families but even genera which are so peculiar and unique in the variation of their species that the *variable* might with advantage be added to the *structural* diagnosis. In the Rhynchota this is extremely applicable, even structural characters which are constant and specific in one genus being variable and of no specific value in another, whilst colour and size, generally of no moment, are in some few instances beacons which denote specific differentiation.

In studying a work of this nature we become sensible of the vast unexplored field of entomology. We here possess the identifications and names of the forms constituting a fauna, but by what methods its homogeneity was secured remains still to be discovered. Which species or genera are even pleistocene forms which have been introduced by man, or by other means of involuntary migration, we have at present no record. The interdependence on the botanical geography of the district must always be a factor in the distribution of the non-carnivorous forms of the Rhynchota, and the meteorological conditions of a country will in future be more studied by entomologists who are investigating local faunas.

Prof. Berg has introduced a valuable addition to his work in the descriptions, where possible, of immature forms. Larvæ in this order are most difficult to adequately describe, and we may hope that the author in

some subsequent publication may be able to give us illustrations of the same.

W. L. DISTANT

### THE HUMAN VOICE

*The Mechanism of the Human Voice.* By Emil Behnke, Lecturer on Vocal Physiology at the Tonic Sol-fa College. (London: J. Curwen and Sons, 1880.)

THE object of this little book is to give singers a plain and comprehensible view of the musical instrument on which they perform. The author seems to have succeeded in this attempt remarkably well. He has evidently had much practical work himself, and has especially set himself the task of examining the action of the vocal organs during singing by means of the laryngoscope, and his record of his own experience in acquiring the use of that beautiful instrument is not only interesting but of much practical value. The last section of the book is devoted to the teachings of the laryngoscope, as to the action of the vocal ligaments in producing voice, with especial reference to the so-called registers. "A register consists of a series of tones which are produced by the same mechanism," is his definition (p. 71), which is new and complete, and he proceeds to explain the different mechanism of each kind of register as actually observed on singers. There are some good remarks on breathing (pp. 17-22). All information is given throughout in clear, intelligible language, and illustrated by fourteen woodcuts (not all original), which are purposely rather diagrammatic in character, in order not to confuse the eye with too many details at a time, but every essential point is gradually introduced. The author seems to have been diligent in the consultation of authorities as well as in practical work of his own, and the book may be safely recommended to all singers, and others who are desirous of knowing how vocal tones are produced.

There are a few things which may be pointed out in the hope that they will be corrected in a second edition, which ought to be soon required. On p. 4 the author implies that former musical pitch was a major to a minor third flatter than at present. For all music now sung the difference was scarcely more than a semitone. On p. 30, and again on p. 70, he says: "The vocal ligaments, by their vibrations, cut the stream of air passing between them into regular waves." It is difficult to see how these words convey, even metaphorically, a correct conception of what happens. "To cut a stream into regular waves," is not a very intelligible operation. The expression should certainly be altered, and a few lines added to convey the full notion. On p. 37 the author seems to be wrong in considering that glottis (or "tongue" in the singular) refers properly to the vocal ligaments (or "tongues" in the plural). It is merely what he terms the "chink," or the tongue-shaped space between the vocal ligaments as shown in Pl. X. A. He also omits to notice especially the cartilaginous glottis between the pyramids (arytenoids), although it appears in Plate X. C, and XIV., XV., XVI. On p. 44 he gives as a function of the pockets (ventricles of Morgagni) that "they allow the stream of air which has just been converted into tone to expand sideways, thereby materially adding to its resonance." The whole phrase is confused and should be entirely re-written; the

conversion of a "stream" into a "tone," and "adding" to the "resonance" of such a converted stream, is very slipshod-writing. On the whole matter of resonance (p. 46) the writer is unsatisfactory. He does not include the cavities between the vocal ligaments and the lid (epiglottis) among the resonating chambers, except in the objectionable passage just cited, and he does not enter into the question of the modification of quality of tone by means of these resonances. By some accident in engraving Plate XIII. the letter *w* is placed on the windpipe, as well as on the cartilages of Wrisberg, and the vocal ligaments are not distinct enough. All the figures, XIII. to XVI., seem to be copied from the English edition of Madame E. Seiler's "Voice in Singing." It is a pity to waste space in such a little book on controversy. It was hardly necessary to quote Madame E. Seiler at length (pp. 81-90), and then controvert many of her statements. This only tends to confuse the learner. The result should be given from the author's own observations, and then, if desired, the points of difference might be explained in a note. Similarly for the controversy about the action of the "wedges" (cuneiform cartilages) on p. 45, which has no interest or use for a beginner. The space devoted to controverting Mr. Lunn's "Philosophy of Voice" (pp. 52, 69, 70), and to Mr. Illingworth's "hazelnut" theory of the "pockets," and other bits of controversy with Miss Sabilla Novello (p. 30) and Dr. Garrett (p. 32) might also have been saved with advantage.

It takes much space to point out a few minor blemishes that scarcely detract from the general merits of the book, which is clearly the result of much real work and careful observation.

#### OUR BOOK SHELF

*Keith Johnston's Illustrations of Electricity and Magnetism.* By W. Lees, M.A. (W. and A. K. Johnston, Edinburgh and London.)

MESSRS. W. and A. K. JOHNSTON have begun an excellent work in issuing these four sheets of diagrams in illustration of the fundamental experiments of electricity and magnetism. The subjects are well chosen, and with hardly any exception well drawn and coloured. They will be welcomed by teachers of science classes in schools for their clearness and general excellence. Mr. Lees, who has prepared them, has also issued a specially-written "Handbook" to accompany each sheet. Of these handbooks—though perhaps useful for such pupil-teachers as may have the misfortune to be set to teach a subject in which they have themselves never made a single experiment—the less said the better. The writer of them is in bondage to the ideas of half a century ago. Take as a specimen the following statement concerning the Leyden jar:—"Suppose, then, the accumulation of electricity in the jar to proceed, the quantity of free electricity in the inner coating goes on also increasing, *until the density of that electricity becomes the same as the density of the electricity of the prime conductor.*" The italics are the author's own! This is no more absurd, as a scientific statement, than it would be to say that when a dock-sluice is opened the water rushes in from the higher level until the muddiness of the water inside is as great as the muddiness of the water outside; for the electric equilibrium of two conductors no more depends upon the *density* of their respective charges than does the flow of water upon its degree of turbidity. Yet the writer of this amazing sentence styles himself "Lecturer on Natural Philosophy, Edinburgh." For the sheets of diagrams themselves we have nothing but praise.

#### LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

#### A Fourth State of Matter

MR. CROOKES has given us optical evidence of the existence of matter in a state of tenuity known hitherto only indirectly, and considers himself warranted in affirming the discovery of a fourth or ultra-gaseous condition; yet it can scarcely be conceded that he has demonstrated the truth of his views, or that his recent exposition of them has strengthened his position or satisfied the doubts of the sceptical. It is simply a question of the use or misuse of certain specific terms, and it is difficult to follow the logic which justifies the creation of a "fourth state" by the attribution of properties not differing essentially from those of matter in its normal condition. Before his contention be granted it should be proved that the substance under experiment possesses properties exclusively and inalienably its own; as rigidly defined as those which distinguish the solid from the liquid, or the latter from the gaseous.

By the abstraction from his experimental chamber of a large portion of its contents he has enlarged the interstitial spaces of the residual gas, and thus amplified the mean free path of molecular vibration from some millionths of an inch to several inches; but beyond this extension of the path of oscillation there seems nothing to warrant the opinion that the residual gas is essentially other than it was before.

If this amplification of the molecular path be the feature relied on for justifying the term "fourth state"—and this seems the only inference—then further travel in this direction brings us to a point easily within our conception, where the contents of the experimental chamber shall not exceed one or two molecules; and it becomes interesting to know if Mr. Crookes would then add a *fifth* to the other states of matter. To do so would seem the inexorable outcome of his reasoning, and inevitably resolves the question into one of the numerical contents of the chamber; and it rests with him to define the precise point where the ordinary conditions cease, and the *ultra-gaseous* commences.

In gases, whether at the normal density, or rarefied to 3 mm., we have an unbroken continuity of condition; which, contrasted with the solid and liquid forms of matter, is noticeable for the absence of any point whence a new state can be said to originate: would Mr. Crookes assign a vacuum of 0.999 mm. or one of 0.0003 mm. as the critical point in the attainment of his "fourth state" or some intermediate density?

Again, has Mr. Crookes fully recognised the distinction between the properties of matter *per se* and those which are referable to electrical agency as revealed by the experiments of Messrs. De La Rue and Müller, where the projection of molecules against the walls of the containing vessel is attributed to electrification; or, further, the fact that a tenuity approaching that attained in his experimental chambers has been long familiar to us in the case of steam of very high pressure?

Whatever may be the solution of our speculations regarding the ultimate condition of matter, opinion seems unanimous that the concrete form in which it is known to us consists of an aggregation of particles having immutable properties and composition, gaseous bodies being definite molecular groupings of such particles; and if such be the case, and the chemical character of the contents of Mr. Crookes' experimental chambers remained unaltered, it is difficult, if not impossible, to conceive the existence of any further condition other than that produced by the breaking up of the molecule into its component atoms.

London, July 9

GEO. E. NEWTON

#### Permanent Record of Foucault's Pendulum Experiment

SOME four years since, while arranging a Foucault's pendulum for use in the class-room, it occurred to me to endeavour to obtain a permanent record of the experiment, and as the results were very good, and the method simple, they may be interesting to others.

The pendulum used was sixteen feet long, the height of my lecture-room at the Massachusetts Institute of Technology, and